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Simulation of Planar Wave Instabilities in Liquid-Fluidized Beds

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We have performed discrete particle simulations in a fully periodic domain at conditions that are representative for liquid fluidized beds. Our three-dimensional unsteady simulations employ lattice-Boltzmann discretization of the Navier–Stokes equations for solving the fluid flow. The particles interact with the fluid through hydrodynamic forces, and with each other via hard-sphere collisions and by the leading order term of the normal lubrication force. Starting from a case with a very high volume fraction of particles, we have examined the dynamics of the flow at progressively smaller solids volume fractions in the periodic domain. The simulation results show the experimentally observed transition from homogeneous fluidization to a planar wave regime. The wave speed corresponds nicely with experimental observations. The simulations reveal detailed information with respect to spatial variation of fluid-particle interaction, and particle phase pressure.

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